

64. A cleaning composition for use in semiconductor integrated circuit fabrication, the cleaning composition consisting essentially of a dilute aqueous solution of phosphoric acid and acetic acid, wherein the phosphoric acid is of a concentration of about 5% by volume or less and the acetic acid is of a concentration of about 30% by volume or less.

65. The cleaning composition of claim 64, wherein the phosphoric acid is of a concentration of about 5% or less by volume and the acetic acid of a concentration of about 10% or less by volume.

66. The cleaning composition of claim 64, wherein the phosphoric acid is of a concentration of about 5% or less by volume and the acetic acid is of a concentration in the range of about 20% by volume to about 30% by volume.

67. A cleaning composition for use in semiconductor integrated circuit fabrication comprising phosphoric acid and acetic acid, wherein the composition includes phosphoric acid at a concentration of about X% by volume or less, where X is 5, and acetic acid at a concentration of about (100-X)% by volume or less.

68. The cleaning composition of claim 67, wherein the composition is a dilute composition, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration of about 30% by volume or less, and deionized water.

69. The cleaning composition of claim 68, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration of about 10% by volume or less, and deionized water.

70. The cleaning composition of claim 68, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration in the range of about 20% by volume to about 30% by volume, and deionized water.

-----claim tree-----

64----65  
+-----66

67----68----69  
+-----70

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438/753  
510/263  
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-----references-----

Patent #: 6313048

This reference scored: 443

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ;

acetic ; concentration ; 30% ; less ; 10% ; volume ; 20% ; includes ; (100-X)% ; deionized ; water ; stripper ; cleaning method ; cleaning composition ; solvent ; clean ; composition ;

Relevant to claims: #64(88),

1. A cleaning method in a semiconductor fabrication process, comprising:  
providing a dilute composition consisting essentially of phosphoric acid  
and acetic acid, wherein the dilute composition includes phosphoric acid  
at a concentration of about 5% or less by volume and acetic acid at a  
concentration in the range of about 20% by volume to about 30% by volume;  
and  
exposing a surface to the dilute composition.

Relevant to claims: #68(62),

20. A cleaning method in a semiconductor fabrication process, the method  
comprising:  
providing a structure including a patterned conductive layer;  
providing a dilute composition consisting essentially of phosphoric acid,  
acetic acid, and deionized water, wherein the dilute composition includes  
phosphoric acid at a concentration of about 5% or less by volume and  
acetic acid at a concentration in the range of about 20% by volume to  
about 30% by volume; and

Patent #: 6310020

This reference scored: 54

Keywords: semiconductor ; aqueous ; solution ; phosphoric ; acid ; acetic ; 30% ; less ; 10% ; 20% ;  
includes ; water ; stripper ; solvent ; rinse ; alcohol ; composition ;

Relevant to claims: #64(27),

0.01 to 90% by weight of an organic acid and/or a salt thereof,  
0.5 to 90% by weight of an organic solvent,  
wherein a pH of the stripping composition is less than 8; and

Patent #: 5972862

This reference scored: 255

Keywords: cleaning ; semiconductor ; circuit ; aqueous ; solution ; phosphoric ; acid ; acetic ; 30% ; le  
ss ;

10% ; volume ; 20% ; includes ; water ; stripper ; solvent ; wash ; clean ; surfactant ;  
alcohol ; composition ;

Relevant to claims: #64(66),

8. The cleaning liquid according to claim 6, wherein said inorganic acid is  
boric acid or phosphoric acid.

9. A cleaning liquid in the form of an aqueous solution for cleaning a  
semiconductor device during production of a semiconductor device, which  
comprises

) a water-soluble or water-miscible organic solvent;

Relevant to claims: #65(27),

6. The cleaning liquid according to claim 5, which further comprises (E) a surfactant.
7. The cleaning liquid according to claim 5, wherein said inorganic acid is boric acid or phosphoric acid.
8. The cleaning liquid according to claim 6, wherein said inorganic acid is boric acid or phosphoric acid.

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Patent #: 5560857

This reference scored: 199

Keywords: cleaning ; semiconductor ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ; concentration ; 30% ;  
less ; 10% ; volume ; 20% ; water ; cleaning method ; rinse ; clean ; degreasing ; composition ;

Relevant to claims: #64(48),

removal On

Silicon Wafers Using Dilute Acidic Solutions.

IEEE Transactions On Semiconductor Manufacturing, vol. 6, No. 3, Aug., 1993, pp. 258-267, XP 000399828 Itano et al., Particle removal From Silicon Wafer Surface In Wet Cleaning Process.

Relevant to claims: #65(21),

3. The solution according to claim 2, wherein said acid is selected from the group consisting of phosphoric acid, sulfuric acid, nitric acid, trichloroacetic acid, dichloroacetic acid, hydrochloric acid, monochloroacetic acid and acetic acid, and said salt is selected from the group consisting of ammonium salts and amine salts, and the base is selected from the group consisting of ammonia and amines.
- The present invention relates to a solution for cleaning silicon semiconductors and silicon oxides.
- In the course of production of semiconductor devices, semiconductor wafers and glass wafers are produced, cleaning steps are conducted before various stages.

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Patent #: 6143705

This reference scored: 140

Keywords: cleaning ; semiconductor ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ; concentration ;  
30% ; 10% ; water ; cleaning method ; solvent ; wash ; clean ; surfactant ; alcohol ;

Relevant to claims: #64(30),

removing particles and metallic contaminants without corroding the metallized wirings and without giving adverse effect of planarization on the semiconductor substrate surface can be effectively achieved by use of a cleaning agent which comprises an organic acid having at least one carboxyl group and a complexing agent having chelating ability.

Relevant to claims: #65(14),

It should be noted that though the ability for removing metallic contaminants can be expected by conducting the CA cleaning method using an inorganic acid, such method has some problems exemplified that the metallized wirings being provided on the surface may be damaged, further the insulation film of silicon oxide being provided on the surface may be etched with the inorganic acid.

Therefore, it is necessary to dilute the concentration of the inorganic acid as low as possible, and to reduce the cleaning time as short as possible.

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Patent #: 6143706

This reference scored: 189

Keywords: cleaning ; semiconductor ; integrated ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ;  
concentration ; 30% ; less ; 10% ; volume ; includes ; water ; cleaning semiconductor ; cleaning method ; solvent ;  
rinse ; clean ; surfactant ; composition ;

Relevant to claims: #64(42),

(2) N,N'-bis(2-hydroxybenzyl)ethylenediamine-N,N'-diacetic acid (HED)  
derivatives (ones wherein Z.sub.2 and Z.sub.3 are carboxyl groups):  
N,N'-bis(2-hydroxy-5-methylbenzyl)ethylenediamine-N,N'-diacetic acid  
(HM)

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Patent #: 6228823

This reference scored: 218

Keywords: cleaning ; semiconductor ; integrated ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ;  
concentration ; 30% ; less ; 10% ; volume ; includes ; water ; cleaning semiconductor ; cleaning method ; solvent ;  
rinse ; wash ; clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(49),

ED],  
ethylenediaminedihydroxymethylphenylacetic acid [EDDHMA], and the like.  
(A-10) Phenol derivatives of alkylethers  
3,3'-ethylenedioxydiphenol, and the like.

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Patent #: 6228179

This reference scored: 189

Keywords: cleaning ; semiconductor ; integrated ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ;  
concentration ; 30% ; less ; 10% ; volume ; includes ; water ; cleaning semiconductor ; cleaning method ; solvent ;  
rinse ; clean ; surfactant ; composition ;

Relevant to claims: #64(42),

(2) N,N'-bis(2-hydroxybenzyl)ethylenediamine-N,N'-diacetic acid (HED)  
derivatives (ones wherein Z.sub.2 and Z.sub.3 are carboxyl groups):  
N,N'-bis(2-hydroxy-5-methylbenzyl)ethylenediamine-N,N'-diacetic acid  
(HM)

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Patent #: 6284721

This reference scored: 235

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ;  
acetic ; concentration ; 30% ; less ; 10% ; volume ; 20% ; includes ; deionized ; water ;  
cleaning composition ; solvent ; rinse ; wash ; clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(47),

a fluoride in a dissolved concentration of from about 1 g/L to about 450  
g/L, which releases fluoride ion which reacts with said silicon oxide to  
form fluoro-silicate,  
wherein a composition ratio of said fluoride and said nitrate is from about  
3:7 to about 7:3.

2. A composition for cleaning and etching as claimed in claim 1, wherein

said inorganic acid is sulfuric acid, phosphoric acid or a mixture thereof.

Relevant to claims: #68(31),

1. A composition for chemical cleaning and etching substrates having silicon comprising:  
an inorganic acid dissolved in water at a concentration of from about 35% to about 93% for accelerating etching process;  
a nitrate in a dissolved concentration of from about 1 g/L to about 450 g/L for oxidizing silicon into silicon oxide; and

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Patent #: 6309467

This reference scored: 169

Keywords: cleaning ; semiconductor ; aqueous ; solution ; phosphoric ; acid ; acetic ; concentration ; 30 % ; less ;  
10% ; volume ; 20% ; includes ; water ; cleaning semiconductor ; cleaning method ; rinse ; wash ; clean ;  
surfactant ; composition ;

Relevant to claims: #64(42),

- washing the semiconductor material in a main cleaning in a further stage with an aqueous cleaning solution which contains nitric acid and hydrofluoric acid; and,  
during hydrophilization, washing the semiconductor material in a still further stage with an oxidizing cleaning liquid.
2. The method for producing semiconductor material which has a low metal concentration as claimed in claim 1 further comprising

Relevant to claims: #65(19),

CA Laboratories, W.

Kern Apr. 1994.

1. A method for producing semiconductor material which has a low metal concentration comprising  
washing semiconductor material in a preliminary cleaning in at least one first stage with an oxidizing cleaning solution which contains a mixture of hydrofluoric acid, hydrochloric acid and hydrogen peroxide;

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Patent #: 5763375

This reference scored: 236

Keywords: cleaning ; semiconductor ; integrated ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ;  
concentration ; 30% ; 10% ; water ; cleaning method ; rinse ; clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(54),

8. A cleaning agent consisting of at least one compound selected from the group consisting of hydrogen peroxide, hydrochloric acid, nitric acid, acetic acid, sulfuric acid and phosphoric acid in addition to, or in place of, hydrofluoric acid of claim 1.
9. A method of cleaning a silicon wafer surface wherein the cleaning agent is a cleaning solution of claim 1.
10. A method of cleaning a silicon wafer surface wherein the cleaning agent is a cleaning solution of claim 2.

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Patent #: 6194365

This reference scored: 293

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ;  
acetic ; concentration ; 30% ; less ; 10% ; 20% ; includes ; water ; solvent ; rinse ;  
wash ; clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(63),

6. The composition of claim 1, wherein the composition further comprises at least one reaction accelerator selected from the group consisting of sulfuric acid, phosphoric acid and acetic acid.
7. A composition for cleaning and etching an Si substrate in the fabricating process of single crystal silicon and wafer, which comprises:
  - a) nitrate(s) for oxidizing silicon to silicon oxide;

Relevant to claims: #67(63),

The inhibitor is used for the case that the layer to be formed on metal should be selectively removed but the metal should not be damaged. Example of inhibitors includes amine and amide(s). For the reaction accelerators, sulfuric acid, phosphoric acid, and/or acetic acid are selectively used.

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Patent #: 6265309

This reference scored: 120

Keywords: cleaning ; semiconductor ; integrated ; circuit ; aqueous ; solution ; phosphoric ; acid ; acetic ; 30% ;  
less ; 10% ; volume ; 20% ; includes ; water ; cleaning method ; solvent ; rinse ; wash ;  
clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(47),

A cleaning agent for use in producing semiconductor devices. The cleaning agent is an aqueous solution containing (A) a fluorine-containing compound, (

Relevant to claims: #67(28),

- ) a salt of boric acid and (C) a water-soluble organic solvent;
- (2) A second cleaning agent for use in producing semiconductor devices, which comprises an aqueous solution containing (A) a fluorine-containing compound, (I) a salt of boric acid, (C) a water-soluble organic solvent and (D) a quaternary ammonium salt represented by general formula (I):

Relevant to claims: #68(15),

- (1) A first cleaning agent for use in producing semiconductor devices, which comprises an aqueous solution containing (A) a fluorine-containing compound, (I) a salt of boric acid and (C) a water-soluble organic solvent;
- (2) A second cleaning agent for use in producing semiconductor devices, which comprises an aqueous solution containing (A) a fluorine-containing compound, (

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Patent #: 6044851

This reference scored: 268

Keywords: cleaning ; semiconductor ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic ; concentration ;  
less ; 10% ; volume ; includes ; deionized ; water ; cleaning composition ; solvent composition ; solvent ; rinse ;  
clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(69),

ostoker et al. is directed to a method of cleaning  
polishing residue from a semiconductor device. The ostoker et al. method  
uses a cleaning solution consisting essentially of phosphoric acid and  
hydrofluoric acid.  
As recognized by both Winebarger et al. and

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Patent #: 5977041

This reference scored: 171

Keywords: cleaning ; semiconductor ; integrated ; circuit ; aqueous ; solution ; phosphoric ; acid ; acet  
ic ; concentration ;  
less ; 10% ; includes ; deionized ; water ; stripper ; cleaning composition ; solvent ; rinse ; wash  
;  
clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(41),

Table 1 indicates a summary of the test results. In Table 1, LA is lactic  
acid; AA is acetic acid; the surfactant is SUFYNOL 420 obtained from Air  
Products, Inc. "+++" in Table 1 indicates the most effective residue  
cleaning. "++" in Table 1 indicates moderate effectiveness of residue  
cleaning.

- (1) The metal corrosion can be prevented by washing the wafers with the  
rinse solution of the present invention after stripping before washing  
with water.

Relevant to claims: #68(21),

The same wafer as mentioned in Example 1 was used with the same stripper  
solution as mentioned in Example 1. However, no post-strip rinse solution  
was used and two deionized water rinses were employed instead. The SEM  
inspection result indicated that all the residues were cleaned like  
Example 1 but severe metal corrosion was observed.

Table 1 indicates a summary of the test results. In Table 1, LA is lactic  
acid; AA is acetic acid; the surfactant is SUFYNOL 420 obtained from Air  
Products, Inc. "+++" in Table 1 indicates the most effective residue  
cleaning. "++" in Table 1 indicates moderate effectiveness of residue  
cleaning.

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Patent #: 5972124

This reference scored: 243

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; solution ; phosphoric  
; acid ; acetic ;  
less ; 10% ; volume ; includes ; deionized ; water ; rinse ; wash ; clean ; alcohol ;

Relevant to claims: #64(50),

2. The method of claim 1, wherein the cleaning solution further comprises a  
peroxide.
3. The method of claim 2, wherein a volumetric ratio of the acid to the  
peroxide ranges from approximately 10:1 to 200:1.
4. The method of claim 1, wherein the acid is selected from the group  
consisting of sulfuric acid, hydrochloric acid, hydrobromic acid,  
hydrofluoric acid, nitric acid, formic acid, acetic acid, phosphoric acid,  
perchloric acid, perbromic acid, performic acid, and peracetic acid.

Relevant to claims: #68(34),

12. The method of claim 1, wherein the liquid comprises an acid diluted  
with deionized water to produce a pH between 6.0 and 7.0.
13. The method of claim 1, wherein the semiconductor topography comprises a  
dielectric surface.
14. The method of claim 1, wherein said applying a cleaning solution  
comprises applying the cleaning solution for approximately 1-30 minutes.



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Patent #: 6235693

This reference scored: 147

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ;  
acetic ; concentration ; less ; 10% ; volume ; includes ; deionized ; water ; cleaning method ; cleaning composition ;  
solvent ; rinse ; clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(31),

Some combinations of components require the addition of acids and/or bases to adjust the pH to an acceptable value. The acids suitable for use in the present invention are organic or inorganic. The acids can include nitric, sulfuric, phosphoric, hydrochloric acids (though hydrochloric acid can be corrosive to metals) and the organic acids, formic, acetic, propionic, n-butyric, isobutyric, benzoic, ascorbic, gluconic, malic, malonic, oxalic, succinic, tartaric, citric, gallic. The last five organic acids are examples of chelating agents.

--ST, --H, --Halogen, --CO.sub.2 H and --CH.sub.2 --CO.sub.2 H,  
--CHOH--CO.sub.2 H

Concentrations of the acids can vary from about 1 to about 25 wt percent.

The important factor is the solubility of the acid and base products with any additional agents in the aqueous solutions.

Relevant to claims: #68(21),

The cleaning composition contains water. Typically high-purity deionized water is used.

The composition optionally contains corrosion inhibitors. Suitable corrosion inhibitors include inorganic nitrate salts such as ammonium, potassium, sodium and rubidium nitrate salts, aluminum nitrate and zinc nitrate.

The composition optionally contains chelating agents. Suitable chelating agents are described in commonly assigned U.S. Pat. No. 5,672,577, issued Sep. 30, 1997 to Lee, which is incorporated herein by reference. Preferred chelating agents include catechol, ethylenediaminetetraacetic acid, citric acid, pentandione and pentandione dioxime.

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Patent #: 6261845

This reference scored: 190

Keywords: cleaning ; semiconductor ; integrated ; circuit ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ;  
acetic ; concentration ; less ; 10% ; volume ; includes ; deionized ; water ; solvent ; rinse ;  
wash ; clean ; surfactant ; alcohol ;

Relevant to claims: #64(44),

brochure, 1993, CFM Technologies, Inc., West Chester, PA.

Gise, P. et al., "Semiconductor and Integrated Circuit Fabrication Techniques", Horiki, H. et al., "Wet Etch Cleaning", in Ultraclean Technology Handbook, Ohmi, T. (ed.), Marcel Dekker, 1991, vol. 1, Ch. 3, 805-819.

Relevant to claims: #65(16),

Selected wafers from the vessel were then analyzed for etching rate using a udolph Caliber 300 Elipsometer located in Flanders, N.J. The measured etching rate was plotted against (A) the hydrofluoric acid concentration measured by a conductivity probe located in the drain line and ( ) the hydrofluoric acid concentration calculated using the measured flow rates of concentrated hydrofluoric acid and deionized water. The plot is shown in FIG. 2 and the data actually used to form the plot is shown in Table 1.

Relevant to claims: #67(39),

brochure, CFM  
Technologies, West Chester, PA.  
brochure, 1993, CFM Technologies, Inc., West  
Chester, PA.  
Gise, P. et al., "Semiconductor and Integrated Circuit Fabrication  
Techniques",

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Patent #: 6372410

This reference scored: 190

Keywords: semiconductor ; integrated ; circuit ; dilute ; aqueous ; solution ; phosphoric ; acid ; acetic  
; concentration ;  
30% ; 10% ; includes ; water ; solvent ; rinse ; wash ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(35),

13. The resist stripping composition according to claim 12, wherein the corrosion inhibitor includes at least one of the phosphoric acid-based chelate compounds.
14. The resist stripping composition according to claim 1, wherein the carboxylic acid-based chelate compounds are selected from the group consisting of ethylenediaminetetraacetic acid, dihydroxyethylglycine and nitrilotriacetic acid.
15. The resist stripping composition according to claim 14, wherein the corrosion inhibitor includes at least one of the carboxylic acid-based chelate compounds.

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Patent #: 5855811

This reference scored: 268

Keywords: cleaning ; semiconductor ; fabrication ; dilute ; aqueous ; solution ; phosphoric ; acid ; acet  
ic ; concentration ;  
less ; 10% ; volume ; includes ; deionized ; water ; cleaning composition ; solvent composition ; sol  
vent ; rinse ;  
clean ; surfactant ; alcohol ; composition ;

Relevant to claims: #64(69),

ostoker et al. is directed to a method of cleaning  
polishing residue from a semiconductor device. The ostoker et al. method  
uses a cleaning solution consisting essentially of phosphoric acid and  
hydrofluoric acid.  
As recognized by both Winebarger et al. and